

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference SYN51021/WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/GB 03/00184	International filing date (<i>day/month/year</i>) 17.01.2003	Priority date (<i>day/month/year</i>) 23.01.2002
International Patent Classification (IPC) or both national classification and IPC C07C7/12		
Applicant JOHNSON MATTHEY PLC et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 24.07.2003	Date of completion of this report 11.02.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Jardon Alvarez, J Telephone No. +49 89 2399-8325 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/GB 03/00184**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-5 as originally filed

Claims, Numbers

1-13 filed with telefax on 06.01.2004

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages: .
- ☐ the claims, Nos.: .
- ☐ the drawings, sheets: .

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

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**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-13
	No: Claims	
Inventive step (IS)	Yes: Claims	1-13
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-13
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

D1: DATABASE WPI Section Ch, Week 199807, AN 1998-075485
D2: DATABASE WPI Section Ch, Week 199303, AN 1993-021908
D3: DD - A - 224 038
D4: US - 4 614 592
D5: US - 2 592 523
D6: US - 5 401 393
D7: EP - A - 0 319 615
D8: FR - A - 2 512 051
D9: US - 6 027 636

1. None of the available documents discloses a process for the removal of elemental sulphur from a non-aqueous liquid feedstock comprising passing the feedstock through a bed of an ion exchange resin containing primary or secondary amino groups (claims 1 to 8), a method for the preparation of a sulphided resin as claimed on claim 9, the sulphided resin obtained by said methods (claim 10) or its use for the removal of mercury and organic mercury compounds (claims 11 - 13).

Prior art methods for the preparation of sulphided resins include the use of water soluble sulphides (see D1 - D2), exchanging different sulphur compounds (alkali sulphides, alkali hydrogen sulphides, thiocyanates, thiourea and thiosemi-carbazides) with a chlorine-group containing resin (see D3), treatment with a metal sulphide and an iron compound (see D4) or use hydrogen sulphide and mercaptans (see D5).

The subject-matter of the claims is then novel (Art. 33(2) PCT).

2. The subject-matter of the claims also involves an inventive step (Article 33(3) PCT).
 - 2.1. The problem underlying the present application (see page 1 of the description) can be seen as to provide a process for the removal of elemental sulphur and organic or inorganic di- or poly-sulphides from a non-aqueous liquid feedstock.

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- 2.2. This problem is solved by the claimed process using a bed of an ion exchange resin containing primary or secondary amino groups. By using such process sulphur is absorbed and removed from the feedstock (see examples).
- 2.3. Document D5 discloses a close related process for the removal of weakly acidic sulphur compounds like hydrogen sulphide and mercaptans (see claim 1). It gives, however, no hint to the use of such resins for the removal of elemental sulphur or polysulphides. There is also no hint into the other available documents which remove sulphur from non-aqueous feedstock by different methods (see D8 and D9) or do not deal with the problem of removing sulphur.

The subject-matter of claim 1 involves then an inventive step.

- 2.4. The subject-matter of claims 2 to 13 which relate to preferred embodiments of the process of claim 1 or include the process steps of such process also involve an inventive step.

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Amended Claims (Art 34 PCT)

1. A method for the removal of elemental sulphur from a non-aqueous liquid feedstock comprising passing the feedstock through a bed of an ion exchange resin containing primary or secondary amino groups.
2. A method according to claim 1 wherein the feedstock is passed through a bed of a hydrogen sulphide absorbent after passage through the bed of the ion exchange resin.
3. A method according to claim 1 or claim 2 wherein water is removed from the ion exchange resin before use.
4. A method according to any one of claims 1 to 3 wherein the ion exchange resin is in the form of a fixed bed of shaped units having maximum and minimum dimensions in the range 0.5 to 10 mm.
5. A method according to any one of claims 1 to 4 wherein the feedstock is contacted with the ion exchange resin bed at temperatures in the range -10°C to +100°C under sufficient pressure that the feedstock is in the liquid state.
6. A method according to any one of claims 1 to 5 wherein the ion exchange resin is periodically regenerated by treatment with an acid.
7. A method according to any one of claims 1 to 6 where the liquid is a hydrocarbon.
8. A method according to claim 7 wherein the liquid is selected from natural gas liquids and gasoline.
9. A method for the production of a sulphided ion exchange resin comprising passing a non-aqueous liquid feedstock containing elemental sulphur or organic or inorganic di- or poly-sulphides through a bed of an ion exchange resin containing primary or secondary amino groups.

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10. A sulphided ion exchange resin containing primary or secondary amino groups obtained by a method as claimed in any of claims 1 to 9.

11. A method for the removal of mercury and organic mercury compounds from a non-aqueous liquid feedstock comprising passing the feedstock through a bed of a sulphided ion exchange resin containing primary or secondary amino groups according to claim 10.

12. A method for the removal of elemental sulphur and of mercury and organic mercury compounds from a non-aqueous liquid feedstock comprising passing the feedstock through a bed of an ion exchange resin containing primary or secondary amino groups wherein at least the inlet portion of the bed of ion exchange resin is sulphided before a mercury containing stream is passed through the bed.

13. A method according to any one of claims 11 to 12 wherein the liquid is a hydrocarbon.

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